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ROTATIONAL SHEARING FILTER

The invention relates to a rotational shearing filter having a housing and a plurality of spaced-apart, coaxial, annular, hollow filter disks arranged therein, whereby held rotationally fast on a rotatable central drive shaft that penetrates the filter disks are a plurality of shearing elements that are adjacent to the annular surfaces of the filter disks in the axial direction of the housing for maintaining their filter permeability for filtrate that penetrates out of the housing into the filter disks.

For proper operating, it is necessary that the shearing elements that act as stirrers never touch the filter disks, because this would lead to immediate destruction of the latter. The drive shaft must be able to absorb forces that occur during operation and must never bow appreciably. For this reason the drive shaft generally comprises metal such as for instance steel or high-grade steel. The drive shaft and the filter disks must have very similar heat expansion behavior in order to avoid having the stirrers or shearing elements come into contact with the filter disks. Therefore the housing is generally produced from the same or at least a very similar material as the drive shaft. If the housing comprises a material other than that of the drive shaft that differs in its expansion behavior from that of the drive shaft, the shearing elements must be spaced relatively distant from the filter disks. This limits the number of shearing elements and filter disks because the effect of the heat expansion increases as the height of the stack increases.

The object of the present invention is to contrive a rotational shearing filter of the type cited in the preamble such that regardless of the material selection, and thus regardless of the thermal expansion behavior of the drive shaft and housing, there is no risk of the shearing elements and the filter disks coming into contact with one another. This is also to be the case when the distances between the shearing elements and the filter disks are selected to be particularly small in order to assure optimum use of space.

For attaining this object, a rotational shearing filter of the type cited in the preamble to clam 1 is inventively distinguished by the features identified in the characterizing portion of the aforesaid claim, specifically in that the shearing elements that are joined to the drive shaft so as to rotate therewith are guided thereon in an axially displaceable manner and in that allocated to the shearing elements are spacers that axially displace the shearing elements corresponding to longitudinal changes in the housing caused by thermal conditions.

Because of this, mutual contact between the shearing elements that act like stirrers and the filter disks can be avoided with certainty in a simple manner. It makes no difference which materials are used for the housing or the drive shaft or how small the distances are between the parts that are movable relative to one another. Constant axial adjustment of the shearing elements occurs corresponding to the heat expansion of the housing and thus corresponding to the positions of the

filter disks that are a function thereof.

The structural form of the spacers in accordance with claim 2 is simple and has proved itself in practical operations.

In accordance with the further embodiments in claims 3 through 6, spacers that are adapted to the housing in terms of their heat expansion properties ensure that no damaging mutual contact occurs.

In accordance with the embodiments in claims 7 and 8, spacers embodied as sliding bushes ensure that damaging mutual contact is prevented. This structural form is particularly simple, economical, and practical.

Additional embodiments that are useful for practical employment result from claims 9 through 11.

In accordance with claim 12, the shearing elements can also be axially displaced by parts of the housing or on the housing in order to prevent mutual contact.

The invention is explained in greater detail in the following using drawings of exemplary embodiments.

Fig. 1 illustrates a simplified section of a rotational shearing filter in accordance with the prior art;

Fig. 2 illustrates a simplified section of a first exemplary embodiment of a rotational shearing filter in accordance with the present invention;

Fig. 3 illustrates a simplified section of a second exemplary embodiment of a rotational shearing filter in accordance with the present invention.

In a known rotational shearing filter in accordance with Fig. 1, a plurality of annular hollow filter disks 2 are arranged spaced apart in a cylindrical metallic housing 1 and held in annular receiving depressions of the housing 1. A suspension for filtering can be introduced into the interior housing areas between the filter disks 2 via a branching suspension inlet 3 embodied in the housing 1. From there the liquid components of the suspension can flow into the interior of the filter disks 2 in a filtered manner and then flow out via a branched filtrate outlet 4 embodied in the housing 1. A housing outlet (not shown) corresponding to the suspension inlet 3 drains the viscous medium enriched with solids out of the housing 1.

In order to prevent loading of the filter disks 2, during operation their surfaces are passed over in a contactless manner by shearing elements 6 that are inserted between the filter disks 2 and that are attached to a rotatably driven central drive shaft 5 so as to rotate therewith. The drive shaft 5 must absorb the forces that occur during operation and must not bow appreciably. Therefore and for attaining matching thermal expansion behavior, in the prior art it generally comprises the same metal as the housing, such as steel or high-grade steel.

The inventive exemplary embodiments in Figs. 2 and 3 are distinguished

from the prior art in accordance with Fig. 1 largely in that the shearing elements 6 attached to the central drive shaft 5 so as to rotate therewith are guided on the drive shaft 5 in a longitudinally displaceable manner. For this purpose it is for instance possible that the drive shaft 5 has at least one longitudinal groove or rib running in the axial direction in which the shearing elements 6 engage rotation-fast with a corresponding profile. The shearing elements 6 can for instance be embodied as annular or disk-shaped parts or even as ray-shaped parts. Their object is to keep the surfaces of the filter disks 2 clean, and thus functional, using contactless relative movements.

In accordance with Fig. 2, located between the longitudinally displaceable shearing elements 6 are annular spacers 7 that are in contact with the latter and that enclose the drive shaft 5 with slight play and that are made of a material, the heat expansion of which largely matches that of the housing 1. In contrast with the prior art, the drive shaft 5 can therefore comprise a material with practically any thermal expansion behavior because the shearing elements 6 are borne longitudinally moveable and their positions are determined by the spacers 7. Since the behavior of the latter is similar to that of the housing 1, due to the material, there is no risk of the shearing elements 6 coming into contact with the filter disks 2.

In the rotational shearing filter in Fig. 2, an end-side shearing element 6 is

positioned against a shoulder (not shown) of the drive shaft 5. At the other end, a pre-tension spring 9 that encloses and is detachably attached to the drive shaft 5 presses against another end-side shearing element 6. This means that all of the shearing elements 6 are pressed against one another with the spacers 7 located therebetween.

In accordance with Fig. 3, the shearing elements 6 that are longitudinally moveable on the drive shaft 5 are held by position using annular spacers 8 that are embodied as sliding bushes, that enclose the drive shaft 5 with a good deal of play, that can comprise any desired material in terms of their thermal expansion behavior, and that are attached to the filter disks 2. Center spacers 8 ensure the correct minimum distance between each adjacent shearing element 6. End-side spacers 8 attached to the housing 1 ensure that adjacent shearing elements 6 maintain the correct minimum distance from the housing 1. The spacers 8 always travel with the adjacent shearing elements 6 in a sliding catch.

In the exemplary embodiment in Fig. 3, as well, the housing 1 and the drive shaft 5 can comprise different materials. The thermal expansion behavior of these parts and also of the spacers 8 is of no consequence because the shearing elements 6 can only approach the filter disks 2 up to the thickness of the spacers 8.

In another exemplary embodiment (not shown), the spacers are embodied

as interior projections or receiving depressions of the housing 1 that extend with the shearing elements 6 into a sliding catch that displaces them axially. These can be components thereof or can be embodied separately. These carrier-like parts also ensure that the shearing elements 6 are axially displaced according to the thermal expansions of the housing 1, and thus also of the filter disks 2.